Form 259
11—10563

DEPARTMENT OF COMMERCE

Bureau of Standards

REPORT

OLR/FSH:EGH
II-8

Letter
Circular
LC 401
Dec.29, 1933

RAILWAY TRACK SCALE TESTING SERVICE

OF THE

NATIONAL BUREAU OF STANDARDS

FISCAL YEAR JULY 1, 1932 TO JUNE 30, 1933.

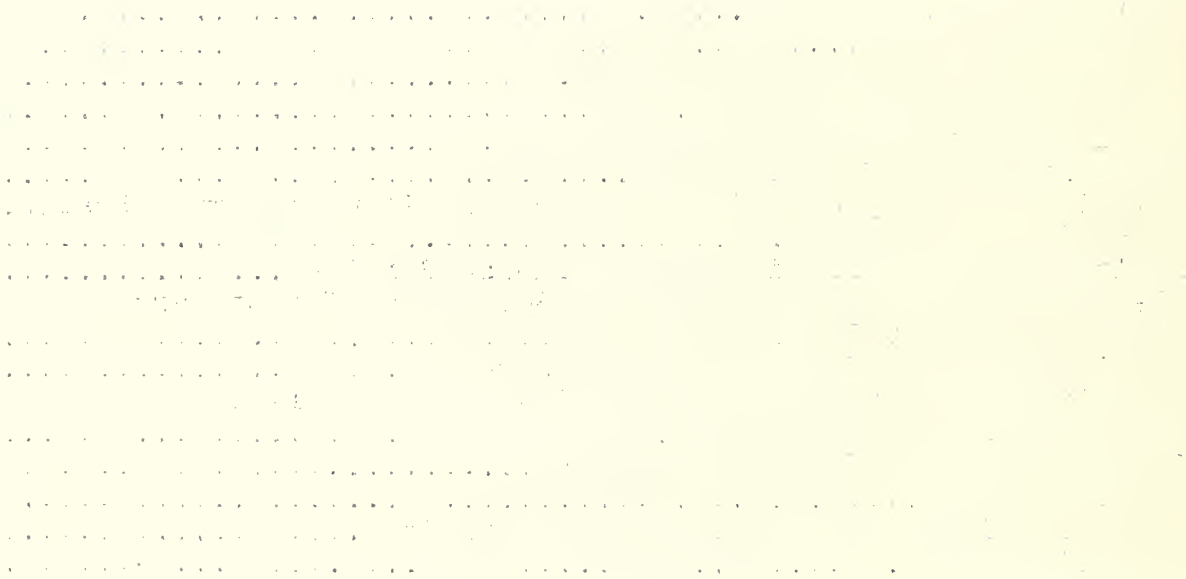
CLR/FSH:EGH

Letter
Circular
LC 401

RAILWAY TRACK SCALE TESTING SERVICE OF THE NATIONAL BUREAU OF STANDARDS FISCAL YEAR, 1933

- --- -

C O N T E N T S



INTRODUCTION

This report of the railway track scale testing service of the National Bureau of Standards is issued for the information of agencies or individuals concerned with problems of railway track scale operation and maintenance and other interests concerned with the accuracy of railway track scales. The period covered by this report is the Federal Government fiscal year 1933 (July 1, 1932 to June 30, 1933, inclusive).

Major features of this report are:

1. The results of the calibrations of master track scales throughout the United States.

2. A statistical summary of the results of 864 track scale tests conducted by the Bureau, and a discussion of significant conclusions suggested by the test data.

3. The results of the standardization of railway track scale test weight cars on the Bureau of Standards master track scale and of the weighing of such cars in the field.

4. A recapitulation of the data on accuracy of railway track scales obtained since 1913 when this work was inaugurated by the Bureau, outlining the improvement which has been effected over this period.

Annual reports of previous issue have discussed the purpose, scope, and administration of the activities in relation to commercial weighing, which are recognized functions of the Bureau. The railway track scale testing service fulfills the responsibility in respect to the large-capacity weighing operations of interstate rail transportation and wholesale commerce, wherein some 8500 railway track scales, widely distributed throughout the country, are employed in weighing commercially several million carloads of material every year.

FIELD ACTIVITIES

During the year all master track scales in the United States were calibrated and in addition tests were made of 864 railway track scales. Tests were made in 39 States and the three units of testing equipment traveled a total distance of more than 23,000 miles on the rails of 87 railways.

A reduction in the amount of funds ordinarily available prevented completion of the field operation schedules originally projected. The total number of tests of railway track scales completed in the year was approximately 10% less than the number for the preceding year.

The routes traveled by the testing equipments and the locations of the 19 master track scales are indicated on the map on the following page. The boundaries of the Eastern, Southern, and Western districts into which the United States is divided for purposes of analysis of test data are shown.

MASTER TRACK SCALE CALIBRATIONS

During the year each of the 19 master track scales distributed throughout the United States, was calibrated.

For master track scales, the fundamental performance requirements are: (1) On preliminary test the maximum error of weight indication for any load at any one of five equidistant positions on the scale rails shall not exceed a "maintenance tolerance" approximating two one-hundredths of one percent (0.02%); (2) on final test following adjustment, no error shall exceed an "adjustment tolerance" equivalent substantially to one one-hundredth of one percent (0.01%).

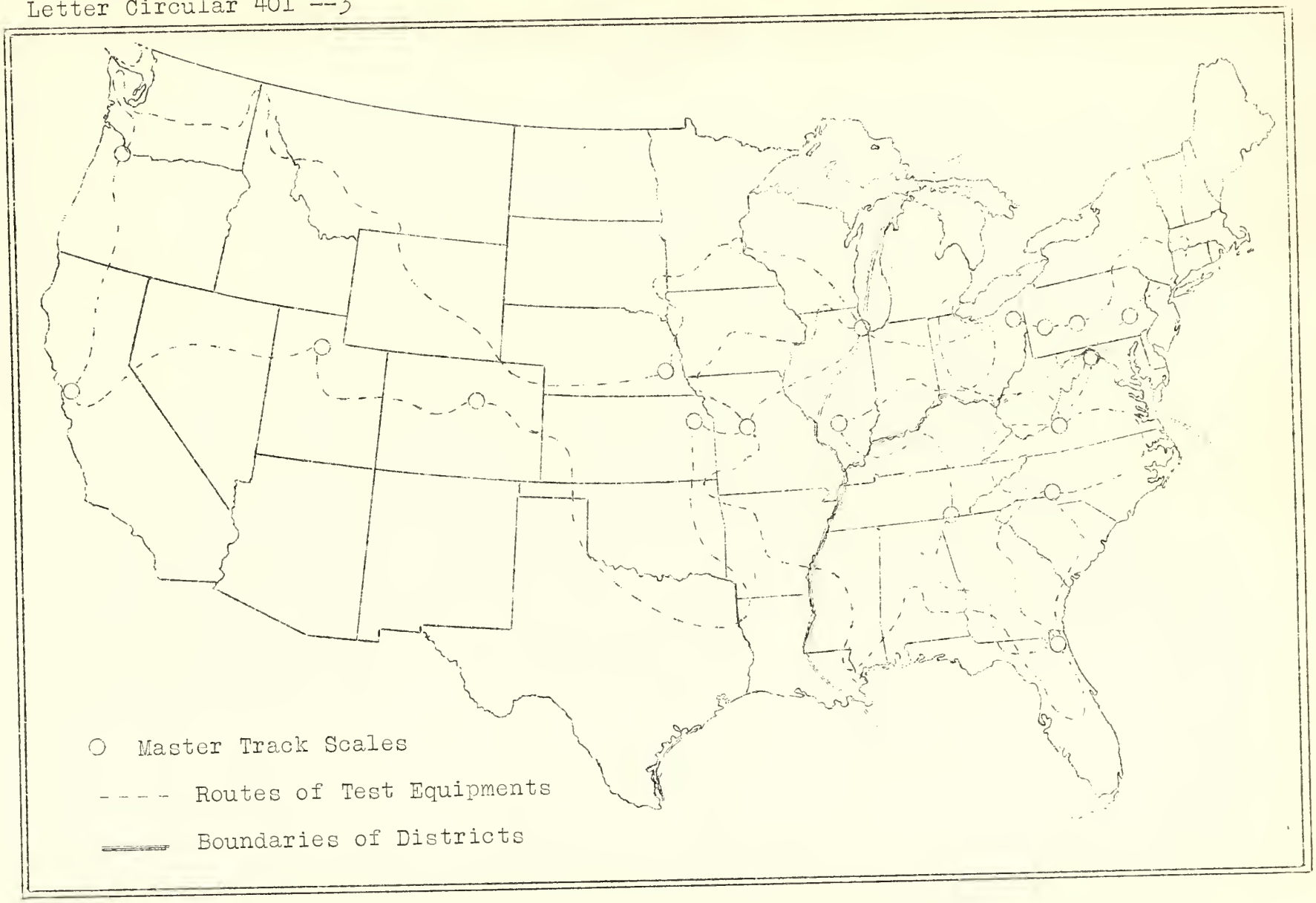
Eighteen master scales, or all but one, conformed to the first-stated requirement; eleven were adjusted or otherwise modified. On final test, all were correct within the adjustment tolerance.

A census of comparatively recent date has fixed the number of track scale test weight cars regularly weighed on these 19 master scales at 130. Considering that inaccuracies developing in master scales are inevitably transmitted to the test cars and through them to the railway track scales of carriers and industry, it will be obvious that regular and authentic calibration of master track scales will always be a function of paramount importance.

RAILWAY TRACK SCALE TESTS

A test of a railway track scale, as it is conducted by the Bureau of Standards, consists, essentially, in applying to the weigh rails of the scale, standard test loads derived from the primary standard of mass which is preserved in the standards vault of the Bureau at Washington. Two test runs each are made with loads of 40,000 pounds and 80,000 pounds placed successively at each of certain specified positions on the scale rails, the weight values indicated by the scale being observed and recorded. With one testing unit, an additional distributed test load of 120,000 pounds is utilized. Observations are also made to determine sensitiveness and permanence of zero balance condition.

An inspection of the scale follows the test. In instances where the character of error and condition of the scale indicate


Master Track Scales
Routes of Test Equipments
Boundaries of Districts

that incorrect adjustment of the lever system constitutes the principal source of error, adjustments may be made to improve the weighing accuracy.

A report giving the results of the test, directing attention to faulty conditions discovered during the inspection, and recommending advisable measures of repair or maintenance is supplied to the scale owner.

Railway track scales are considered to be correct or incorrect according to the requirements of the tolerance adopted by the Bureau. Substantially it is required that the maximum indicated percent error of weighing, computed in accordance with methods detailed on the reverse of the report forms issued, shall not exceed two-tenths of one percent (0.20 percent) in the case of scales, except those used in grain weighing service, and one-tenth of one percent (0.10 percent) for scales in this special class. For the statistical purposes served by table 1 of this report, each scale is listed as "within tolerance" or "not within tolerance" on the basis of the 0.20 percent tolerance whether or not the scale is in grain weighing service. In a subsequent section of the report the accuracy of grain scales is analyzed on the basis of the 0.10 percent tolerance.

The results of the railway track scale tests are summarized statistically in table 1, which follows. Classification of the scales tested is on the bases of location and class of ownership. The districts referred to are those adopted by the Interstate Commerce Commission for reporting "Statistics of Railways in the United States." Scales in the "Railroad"group are those owned by the carriers and used by them to weigh revenue car-load freight. Scales in the "Industrial" group comprise those ordinarily utilized at commercial or industrial establishments for establishing or verifying weights for the purchase or sale of materials. (It may be remarked here that in noticeably increasing degree the carriers are accepting industrial scale weights as a satisfactory basis of freight-haul charges.) The small group of scales classed as "Others" are those owned by the Federal Government, States, or cities; with respect to circumstances of use, they may be said to be in the general category of industrial scales.

Of the 864 railway track scales tested, 568 fall in the railroad group, 291 in the industrial group, and 5 in the group classed as "Others".

Fifty-two scales were adjusted to improve their weighing performance.

TABLE 1. SUMMARY OF RAILWAY TRACK SCALE TEST DATA, FISCAL YEAR 1933

District and Scale Ownership	Number of scales tested	Within tolerance		Not within tolerance		Mean numerical error--percent of applied load	Analysis of Errors of Incorrect Scales					
							Errors in excess(+)			Errors in deficiency(-)		
		Number	Percent	Number	Percent		Number of scales	Percent of incorrect scales	Mean error--percent of applied load	Number of scales	Percent of incorrect scales	Mean error--percent of applied load
EASTERN												
Railroad	190	155	81.6	35	18.4	0.16	25	71.4	0.47	10	28.6	0.36
Industrial	120	98	81.7	22	18.3	0.18	13	59.1	0.54	9	40.9	0.52
Others	2	2	100.0	0	0.0	0.06	0	0.0	0.00	0	0.0	0.00
Totals	312	255	81.7	57	18.3	0.17	38	66.7	0.49	19	33.3	0.44
SOUTHERN												
Railroad	163	114	69.9	49	30.1	0.22	18	36.7	0.36	31	63.3	0.59
Industrial	47	27	57.4	20	42.6	0.21	12	60.0	0.27	8	40.0	0.47
Others	2	2	100.0	0	0.0	0.12	0	0.0	0.00	0	0.0	0.00
Totals	212	143	67.5	69	32.5	0.21	30	43.5	0.32	39	56.5	0.57
WESTERN												
Railroad	215	187	87.0	28	13.0	0.14	15	53.6	0.36	13	46.4	0.53
Industrial	124	111	89.5	13	10.5	0.12	8	61.5	0.33	5	38.5	0.31
Others	1	0	0.0	1	100.0	0.30	0	0.0	0.00	1	100.0	0.30
Totals	340	298	87.6	42	12.4	0.13	23	54.8	0.35	19	45.2	0.46
ALL DISTRICTS												
Railroad	568	456	80.3	112	19.7	0.17	58	51.8	0.41	54	48.2	0.53
Industrial	291	236	81.1	55	18.9	0.16	33	60.0	0.39	22	40.0	0.45
Others	5	4	80.0	1	20.0	0.13	0	0.0	0.00	1	100.0	0.30
GRAND TOTALS	864	696	80.6	168	19.4	0.17	91	54.2	0.40	77	45.8	0.51
1932 totals	959	768	80.1	191	19.9	0.17	122	63.9	0.36	69	36.1	0.61

Discussion of Test Results. Attention may first be directed to the first, third, and sixth columns of figures in the preceding table.

The first column of figures, recording the number of scales tested in each separate and collected group classification of location or ownership, enables the reader to form a general conception of the distribution of the testing service. It will be observed that very nearly two-thirds of all the scales tested were in the railroad-owned group. Considering that railroad-owned track scales compose less than half the total number of track scales, the foregoing circumstance seems to denote a somewhat disproportionate division of tests. In partial explanation it may be said that in the past two years very many industrial scales have been temporarily withdrawn from use because of the discontinuance or curtailment of plant operation.

The values in column 3 are the percentages of scales found, on test, to be correct in each ownership and location group. They are considered to be generally representative of the proportion of correct scales in each separate group. An exception is the group of industry-owned scales tested in the Southern district; it is felt that the data here are not sufficient to justify the assumption that they are necessarily representative. Of special interest are the totals for each district, values for the Eastern, Southern, and Western districts being respectively 81.7, 67.5, and 87.6 percent. The comparative accuracy for the three districts is substantially the same as has been found previously. The grand total percentage of correct scales is 80.6 percent. While this establishes a new record for the proportion of scales found to be correct in any year of Bureau investigation, actually the increase over the figure found last year, 80.1 percent, is so small as not to be significant. The percentages of industry-owned scales and railroad-owned scales found correct in the Western district are 89.5 and 87.0 percent, respectively. The superior percentage of correct scales in the Western district may be attributed largely to a relatively high proportion of modern weighing equipment, to the prevalence of less rigorous conditions of traffic, and to more intensive scale supervision by railways and weigh-bureau agencies.

In the sixth column are tabulated the mean numerical errors - percent of applied load - for scales in each group. The errors for Eastern, Southern, and Western districts are 0.17, 0.21, and 0.13 percent, respectively. It is worthy of note that these values are consistent with the district comparison made on the basis of percentages of correct scales. A circumstance illustrative of the general accuracy standards being currently maintained, is that the average error for all scales tested is 0.17 percent; this figure, which is the same as the

figure for last year, is substantially less than the tolerance value (0.20 percent). Indeed, only in the Southern district is the average error greater than the tolerance, and in this case only very slightly so.

The customary study of error characteristics for incorrect scales comprises the right hand section of table 1. The number of incorrect scales for individual groups being small, conclusions as to group characteristics would be ill-advised. However, the total values, indicating an approximately equal division of incorrect scales having errors in excess and errors in deficiency, corroborate previous conclusions that there is no consistent tendency toward weight indications either in excess or in deficiency.

Comparison of all totals for this year with corresponding items for the preceding year, may be made at the foot of the table. The value differences are not of material proportions.

ERROR FREQUENCY DISTRIBUTION

Table 2 has been prepared to illustrate the frequency distribution of the errors in scales of the location and ownership groups. In accordance with established practice there are not included in this tabulation the errors of those scales not owned by railroads or industries - five scales in the case of this report. At the foot of the table the mean errors are noted and these may be compared with the corresponding items for last year, which are also given for convenience of reference.

In comment on the data in the table, three facts may be cited: 1. For both major classes of ownership 50 percent or more of the scales tested exhibited errors within one-half the tolerance. 2. Contrary to the experience of recent years, no appreciable difference in the error distribution for the two major ownership classes is apparent. 3. Some degree of improvement in the accuracy of industry-owned scales is indicated.

TABLE 2. FREQUENCY DISTRIBUTION OF RAILWAY TRACK SCALE ERRORS - FISCAL YEAR 1933

Errors--percent of applied load	EASTERN DISTRICT		SOUTHERN DISTRICT		WESTERN DISTRICT		ALL DISTRICTS	
	Railroad 190 scales	Industrial 120 scales	Railroad 163 scales	Industrial 47 scales	Railroad 215 scales	Industrial 124 scales	Railroad 568 scales	Industrial 291 scales
	Percent of scales tested	Percent of scales tested	Percent of scales tested	Percent of scales tested	Percent of scales tested	Percent of scales tested	Percent of scales tested	Percent of scales tested
0.00 to 0.05 incl.	19.5	17.5	20.2	6.4	31.7	25.8	24.3	19.3
0.06 to 0.10 "	28.4	31.7	27.0	23.4	22.3	33.1	25.7	30.9
0.11 to 0.15 "	21.6	18.3	16.0	10.6	20.9	19.3	19.7	17.5
0.16 to 0.20 "	12.1	14.2	6.7	17.0	12.1	11.3	10.6	13.4
0.21 to 0.25 "	4.2	4.2	6.7	23.5	2.8	3.3	4.4	6.9
0.26 to 0.30 "	2.6	4.2	5.0	6.4	3.2	1.6	3.5	3.4
0.31 to 0.35 "	5.3	2.5	4.3	0.0	1.9	2.4	3.7	2.1
0.36 to 0.40 "	2.1	0.0	2.5	2.1	0.9	1.6	1.8	1.0
0.41 to 0.45 "	1.1	0.7	1.8	0.0	0.9	0.8	1.2	0.7
0.46 to 0.50 "	2.1	0.8	1.2	2.1	0.9	0.8	1.4	1.0
0.51 to 1.00 "	0.5	4.2	6.1	8.5	1.9	0.0	2.6	3.1
Over 1.00	0.5	1.7	2.5	0.0	0.5	0.0	1.1	0.7
Mean errors--percent of applied load	0.16	0.18	0.22	0.21	0.14	0.12	0.17	0.16
Mean errors--percent of applied load Fiscal year 1932	0.15	0.22	0.18	0.18	0.13	0.20	0.15	0.20

RELATIVE ADEQUACY OF RAILROAD-OWNED AND INDUSTRY-OWNED SCALES

Data on percentages of correct scale and mean error values, of railroad-owned and industry-owned scales, for the past ten years, are assembled in table 3, which follows:

TABLE 3. RELATIVE QUALITY OF PERFORMANCE OF RAILROAD-OWNED AND INDUSTRY-OWNED TRACK SCALES.

1	2	3	4	5	6	7
Year	Percentage of scales tested that passed the tolerance		Difference (2)-(3)	Average error in percent of applied load		Difference (6)-(5)
	Railroad-owned	Industry-owned		Railroad-owned	Industry-owned	
1924	57.9	54.3	+3.6	0.36	0.36	0.00
1925	67.2	63.3	+3.9	0.28	0.25	-0.03
1926	66.9	64.1	+2.8	0.26	0.22	-0.04
1927	72.0	68.1	+3.9	0.20	0.22	+0.02
1928	73.9	63.5	+10.4	0.23	0.24	+0.01
1929	74.0	68.4	+5.6	0.19	0.21	+0.02
1930	76.2	67.6	+8.6	0.19	0.22	+0.03
1931	79.9	72.3	+7.6	0.16	0.25	+0.09
1932	81.4	77.6	+3.8	0.15	0.20	+0.05
1933	80.3	81.1	-0.8	0.17	0.16	-0.01

Review of Subject. Table 3, preceding, is arranged in the same form as in several reports immediately preceding this one, this arrangement being especially designed to show the comparative quality of performance of railroad-owned and industry-owned scales. The table now embraces a ten-year period. In columns 2 and 5 are shown the percentage of accuracy and the average error, respectively, of railroad-owned scales. Columns 3 and 6 contain the same information for industry-owned scales. In columns 4 and 7 the differences are shown. From these data for a period of years terminating in 1931 the conclusion was drawn that improvement in industrial weighing was not keeping pace with

improvement in railroad weighing; in fact the average error of industry-owned scales found in 1931 was larger than it had been for several preceding years. In 1932, however, the figures for industry-owned scales indicated that this class of scales was improving more rapidly than railroad-owned scales. The figures for this year entirely close the gaps formerly existing. On the basis of the tests made on railroad-owned and industry-owned scales this year, it can not be said that either class is superior to the other in accuracy of weighing.

RAILWAY TRACK SCALES IN GRAIN-WEIGHING SERVICE

It is customary to consider as a separate group those railway track scales employed for weighing bulk grain in carload lots. This differentiation arises from the fact that a special tolerance, recommended by the Interstate Commerce Commission and requiring a higher grade of weighing performance than that fixed for other track scales, is applied by the Bureau.

During the past fiscal year tests were made of 58 railway track scales subject to the grain scale tolerance. The essential data are as follows:

1. Thirty-four scales, or 58.6 percent, were correct within the grain scale tolerance and 24 scales, or 41.4 percent, were incorrect.

2. The mean numerical percent error for the entire number of scales was 0.13 percent, appreciably more than the tolerance value.

As has been repeatedly asserted, modern specification-type railway track scales, contemplated as equipment for grain weighing when the special grain scale tolerance was promulgated in connection with Docket 9009 of the Interstate Commerce Commission, have not in a very material degree replaced the lighter types of track scales at grain mills or elevators. In the principal terminal grain markets this deficiency in equipment is partially neutralized by the effectiveness of vigilant maintenance on the part of agencies supervising grain weighing. At outlying points where such supervision is lacking and where track scales are the prevailing facility for weighing grain, the effect of lack of supervision is apparent.

In table 4, which follows, there have been assembled the essential data on scales in grain weighing for the last eleven years.

TABLE 4. RAILWAY TRACK SCALES IN GRAIN WEIGHING SERVICE

Fiscal year	Number of scales tested	Within special grain scale tolerance		Not within special grain scale tolerance		Mean numerical error -- percent of applied load
		no.	percent	no.	percent	
1923	32	2	6.2	30	93.8	0.40
1924	89	31	34.8	58	65.2	(a)
1925	82	34	41.5	48	58.5	(a)
1926	90	37	41.1	53	58.9	(a)
1927	67	26	38.8	41	61.2	(a)
1928	54	32	59.2	22	40.8	(a)
1929	97	54	55.7	43	44.3	0.15
1930	47	22	46.8	25	53.2	0.15
1931	97	51	52.6	46	47.4	0.12
1932	72	46	63.9	26	36.1	0.13
1933	58	34	58.6	24	41.4	0.13

(a) Values of the mean errors for the years 1924 to 1928, inclusive, are not available.

STANDARDIZATION OF RAILWAY TRACK SCALE TEST WEIGHT CARS ON BUREAU MASTER TRACK SCALE

The master track scale to which the greatest number of railway track scale test weight cars are referred for standardization is that maintained by the Bureau of Standards at Clearing in the suburbs of Chicago, Illinois. Its location, in the yards of the Belt Railway of Chicago, accessible directly to 12 lines terminating on the Belt Railway and accessible through local interchange to the 26 railways serving the Chicago terminal area, has rendered it of maximum utility to the railways.

The results of all determinations are summarized in table 5. Individual cars are designated by letter. Those conforming in essential particulars to recommended specifications for test weight car design are identified by inclosing the letter in a parenthesis ( ). In the tabulation of errors found, a "plus" (+) error indicates that the actual weight of the car was found to be greater than the nominal weight value, a "minus" (-) error the converse. The symbol ° appears in instances where there was record or evidence of repairs or alterations having been made since the last preceding standardization. It should be understood that absence of the symbol ° does not necessarily imply that the corresponding deviation from nominal weight value is attributable entirely to normal causes, but signifies that there was no definite record or indication of other causes.

TABLE 5. STANDARDIZATIONS OF RAILWAY TRACK SCALE TEST WEIGHT CARS ON BUREAU OF STANDARDS MASTER TRACK SCALE, CLEARING, ILLINOIS - FISCAL YEAR 1933

Car designation	Report no.	Nominal weight in pounds	Period since last preceding standardization, in months	Error in pounds (plus)	Error in pounds (minus)
A	226	50,000	12	15	
B	227	92,500	1st occasion	36	
	254		7	78°	
(C)	228	80,000	3		22°
	252		6	43°	
	264		4		2
(D)	229	40,000	3		11
	251		6	20°	
	263		4	0	
(E)	230	80,000	4	14	
	240		3		40°
F	231	60,600	6		50°
	238		3	6	
	253		3	19	
	262		3	2	
(G)	232	80,000	9	30°	
	257		7		147°
(H)	233	80,000	9		26°
	250		3	18°	
	261		4	14°	
(I)	234	80,000	6	22°	
	258		5		4
(J)	235	80,000	11		28°
(K)	236	80,000	5	8	
(L)	237	30,000	5		7
(M)	239	80,000	12		122°
(N)	241	80,000	6		69°

TABLE 5 (Continued)

Car designation	Report no.	Nominal weight in pounds	Period since last preceding standardization, in months	Error in pounds (plus)	Error in pounds (minus)
(O)	242	30,000	6		14°
P	243	60,000	10		15
Q	244	50,000	7		10
(R)	245	80,000	7		11°
	266		7		3
S	246	61,600	6	84°	
	265		5		15
T	247	60,000	22	58	
U	248	61,400	10	44°	
V	249	75,000	7	56°	
W	255	83,000	9	128°	
(X)	256	80,000	7		311°
(Y)	259	80,000	15		7
(Z)	260	40,000	15		6
AA	267	80,000	42	44	
BB	268	80,000	1st occasion		66

Totals		
28 cars	43 standardizations	20 cars heavy; 22 cars light; 1 car correct

Discussion of Standardization Results. In the fiscal year 1933 the Bureau master track scale was utilized for 43 individual standardizations. The number of railway track scale test weight cars involved was 28 and the number of car owners 13. The total number of cars standardized was one more than the number for the preceding year. However, the total number of standardizations was 17 less than in the preceding year. This latter circumstance may be ascribed, in part, to the fact that a general reduction in the working forces of railway track scale maintenance organizations has resulted in occasional idle periods for some cars and in extending the operating schedules of others. It seems probable that the effect of these factors has been to make it less convenient to route these cars to the Bureau master scale with the same frequency as formerly.

The frequency of standardization per car varied from three months to forty-two months; however, in the case of the majority of cars showing intervals greater than twelve months it is known that these are of a group which, at times, may be standardized on other master track scales. To state or recommend a definite time schedule for successive standardizations is not practicable for the reason that the variable elements of use, transit, deterioration, and repair which variously affect weight constancy, cannot well be evaluated in advance or correlated with the duration of testing schedules. Nevertheless, as a general policy, it is considered advisable not to prolong the interval between successive standardizations to more than six months. In relation to this is is pertinent to state that in the case of the Bureau cars requiring standardization at intervals, schedules are so arranged that they will be standardized on a master scale at intervals of approximately three months.

Excluding from consideration all weighings of test weight cars which had probably been repaired since the last preceding standardization, and of all cars not standardized on the Bureau master scale within one year preceding the date of each weighing under discussion, fifteen weighings developed an average error of 8.7 pounds. Six cars weighed more than the nominal value, eight cars less than the nominal value, and one car was substantially correct. In the case of these cars the average period elapsing since the immediately preceding standardization on the Bureau master scale, was 5.3 months. This constitutes a very creditable record of accuracy for cars standardized within a reasonable period.

WEIGHING OF RAILWAY TRACK SCALE TEST WEIGHT CARS IN THE FIELD

In the section devoted to master track scales given earlier in this report, it was stated that the number of test weight cars regularly depending upon master track scales for periodic standardization of their weight values was 130. A supplementary survey has shown the number of test weight cars in use and not regularly referred to master scales for standardization to be 65. These latter cars, either because their operation area lies remote from a master scale or because their wheelbase exceeds the weighrail length of the conventional master scale, are necessarily dependent upon other and less precise methods for establishing their weight values. Their chief recourse is to rely upon infrequent comparison with the Bureau standards on occasions when a unit of Bureau equipment and a railway track scale having performance characteristics suitable for a comparison by substitution weighing methods, happen to be available. During the year the Bureau units, in connection with their track scale testing schedules, weighed 30 test weight cars in this group. Nine cars were found to weigh more than their nominal value, 17 cars less than their nominal value, while four were correct within the limits of error inherent in the field weighing method. Excluding 2 cars with very large errors, which were presumably due to major repairs, the average error determined was 30 pounds.

The 65 test weight cars being discussed here constitute a weakness in the standard-distribution scheme. Because of their widely separated and frequently isolated operation zones, it is not practicable for the Bureau to arrange for annual weighing of the total number. Moreover, in event of damage requiring removal, repair, or replacement of parts, there is no continuously available reference medium for their restandardization. The situation is aggravated by reason of the fact that these cars are, in the main, not constructed in accordance with existing specifications, which are designed to minimize weight variations due to natural causes. It is hoped that ultimately some practicable plan for regular master track scale standardization of all test weight cars may be developed. To the success of such a plan replacement of many unsatisfactory cars with those of specification type will be a prerequisite condition.

RESEARCH AND INVESTIGATION

Research or investigation projects pursued during the past year included:

1. A mathematical investigation of the properties of flanged cast members with particular attention to their transverse bending resistance and to economy of metal distribution.

2. An analytical study of various loading conditions to be considered in fixing a basis for the design of weighbridges in motor truck scales.

COOPERATION WITH TECHNICAL GROUPS

Through representation on the committees of two technical organizations, namely, the American Railway Engineering Association and the National Scale Men's Association, representatives of the Bureau of Standards cooperated in initiating or developing projects designed to improve current practice in the design, construction, maintenance, and use of large-capacity weighing machines. The principal projects were: (1) A revision of the specifications for motor truck, built-in, self-contained, and portable scales used in railway service, and (2) preparation of a suitable standard form for reporting tests of grain hopper scales.

PUBLICATIONS

Letter Circular 353, reporting upon the railway track scale testing service for the fiscal year 1932, was issued and given wide circulation among parties at interest.

An abstract of master track scale calibrations for the fiscal year 1932 was prepared and distributed to a limited number of agencies responsible for supervision over railway weighing.

REDUCTION IN NUMBER OF TRACK SCALES IN USE

A distinct trend toward elimination of numerous branch-line railway weighing stations and toward more general adoption of the "weight-agreement" principle of revenue freight weighing, is in progress. The immediate result of the tendency is to reduce the number of railroad-owned scales in use. An indirect result and one which may be expected ultimately to improve the standards of industrial weighing, is that the railways, relieved in part of the burden of maintenance of railroad-owned track scales, may be enabled to concentrate more attention upon the industry-owned weighing equipment. In the year 1930 a count of the railway track scales in the United States showed the number to be about 9,000, about 42 percent of them being railroad-owned equipment. It is believed that the total number has been reduced to the order of 8,500 with perhaps 40 percent of the number in the railroad-owned class. Thus it is estimated that the number of railroad-owned track scales has decreased by about 400, or 10 percent, during this period. The consolidation of railway terminal operations -- a currently agitated recommendation -- may, if effected, be expected to bring about further decrease in the number of railroad-owned scales.

GENERAL REVIEW

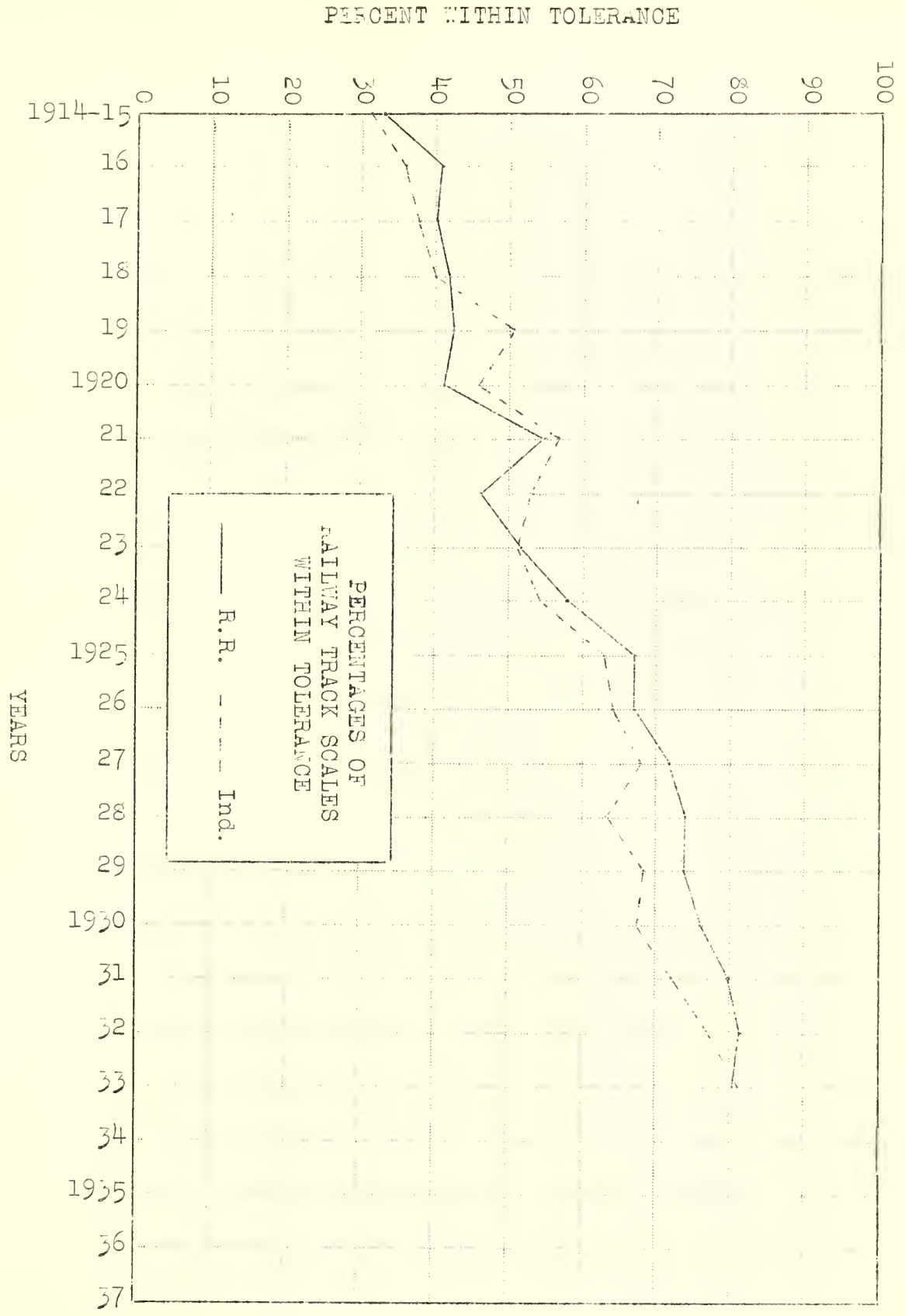
The concern of the Bureau of Standards in improvement and standardization of car-load freight weighing facilities dates from the year 1913 when, following investigation of existing unsatisfactory standards and scales, responsibility for instituting and coordinating improvement measures was undertaken by the Bureau.

Since that time the Bureau of Standards has provided a master track scale to serve as a means for standardization of heavy weights, has calibrated each master track scale in the United States approximately once annually, and has carried out more than thirteen thousand tests of railway track scales in use. Also the Bureau has made many researches and investigations, has cooperated with various interested groups in the preparation of specifications for adequate scales and in other projects designed to improve scales and weighing practices, and has prepared and distributed many publications along the above lines.

These activities have resulted in establishing a correct standard for heavy weights and weighing widely distributed throughout the country, in directly improving the accuracy of a very large number of individual scales, and in focusing the attention of scale owners on the importance of accuracy and the necessity for equipment replacement, repairs, and maintenance. Moreover the data collected and published have furnished a means for measuring progress made and results achieved. During the period under discussion there has been a gradual replacement of obsolete weighing equipment with specification-type scales, and great improvement has been noted in facilities for testing and correcting track scales and in methods of scale maintenance by railways and private scale owners.

The cumulative effect of the various factors aforementioned has been greatly to improve the grade of weighing accuracy obtained generally on railway track scales in the United States. Whereas formerly the degree of accuracy was notably deficient it now compares favorably with those customarily obtained when other classes of comparable commercial measuring instruments are involved. A graphic record of the rate and extent of the progress achieved, is submitted in figures 1 and 2, which follow. To sustain conditions at their present high level under the adverse influence of a deficient scale replacement rate and a weakened program of maintenance will require continued and carefully concerted action by all the agencies whose interest it is to maintain in the weighing operations of trade and transportation a sound foundation of accuracy and equity.

Figure 1


PERCENT WITHIN TOLERANCE
0
10
20
30
40
50
60
70
80
90
100
1914-15
16
17
18
19
1920
21
22
23
24
1925
26
27
28
29
1930
31
32
33
34
1935
36
37
YEARS
PERCENTAGES OF
RAILWAY TRACK SCALES
WITHIN TOLERANCE
R.R.
Ind.

Letter Circular 401--20 Figure 2